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ABSTRACT

Because small for gestational age (SGA) infants are a heterogeneous group known to be at increased risk of learning and behavioral disorders, a study was conducted to replicate and extend findings on developmental patterns of SGA infants in the first year. The study presented, as well, an opportunity to explore the effects, found in a previous larger study, of such a simple intervention as encouraging mothers' tactile stimulation of infants. Results reported are a portion of a short longitudinal study of groups of SGA infants and matched control subjects. Criteria for inclusion in the SGA group were that infants be under the third centile on weight for gestational age charts for New Zealand neonates, that they be more than 37 weeks gestational age, and that they had no identifiable physical or mental handicap. Appropriately growing control group subjects were matched on sex, birth order, and socioeconomic status. Demographic and perinatal data were collected at the time of recruitment. Observations of infants were conducted at 1 month, 3 months, 6 months, and 12 months of age. Complex patterns of results are speculatively discussed. (Appendixes include: (1) 11 references; (2) a list of interaction variables; (3) a table of test results; and (4) 8 figures containing charts of results.) (RH)

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THE TWO-WAY STREET: INTERACTION AND DEVELOPMENT IN SMALL-FOR-GESTATIONAL-AGE INFANTS

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THE TWO-WAY STREET: INTERACTION AND DEVELOPMENT IN SMALL-FOR -GESTATIONAL-AGE INFANTS

I. DESCRIPTION OF STUDY

The results reported here are a portion of a short longitudinal study of groups of small-for-gestational-age (SGA) infants and matched control subjects. In 1986 a total of fifty infants and their mothers were recruited for the study at Christchurch Women's Hospital, where the majority of births take place in the city of Christchurch, New Zealand. All subjects were healthy at birth, although some SGA infants spent 24 hours in an intermediate nursery to monitor temperature control. Criteria for inclusion in the SGA group were that they be under the third centile on weight for gestational age charts for New Zealand neonates, that they be more than 37 weeks' gestational age (to avoid the possibly confounding effects of prematurity), and that they had no identifiable physical or mental handicap. Appropriately grown (AGA) control group subjects were matched on sex, birth order, and socioeconomic status (assessed by the Elley Irving scales based on New Zealand census data). Demographic and perinatal data were collected at the time of recruitment.

II RATIONALE FOR INTERVENTION

Small for gestational age (SGA) infants are an heterogeneous group known to be at increased risk of learning and behavioural disorders (Allen 1984; Neligan, Kolvin, Scott, & Garside 1976; Silva, McGee & Williams 1984). Although there is a considerable body of information about their physical growth and about developmental and learning problems at school age, little is known about their developmental progress in infancy and the preschool years. Some preliminary investigations into this area have been made (Watt & Strongman1985; Watt 1986a).

These previous attempts to discover relationships between interaction parameters and developmental status in SGA infants had produced almost no correlations, despite strong and predictable patterns of correlations for control group infants (Watt 1986a). The only maternal behaviour which approached a positive and significant relationship with development in the first year was a variable measuring tactile stimulation (rocking, patting, hugging, kissing etc). It was hypothesised that soothing physical contact might assist the infant to achieve more stable patterns of state organisation, as it had been found that SGA infants were comparatively disorganised in their states in the first six months (Watt & Strongman 1985). A pilot study was carried out with small numbers of SGA infants in which the effects of encouraging tactile activity in mothers was explored (Watt 1986b). This resulted in surprisingly strong differences in interaction patterns between dyads in whom the mother had been given information about ways of using tactile stimulation, and dyads where general information about infants had been given.

The main aim of the present study was to replicate and extend findings from previous studies about developmental patterns in SGA infants in the first year; it presented, as well, an opportunity to explore the effects found in the pilot study of such a simple intervention in a larger group of SGA infants and their mothers.

III. METHOD

Observations and assessments pertinent to this report were as follows:

One month: A home visit to discuss specific information for the intervention group, and general topics for the control and nonintervention groups.

Three months: observation of interactions during bathing and feeding.

Six months: (a) observation of interactions during bathing and feeding
(b) developmental assessment (Bayley Scales)

Twelve months: developmental assessment (Bayley Scales)

The SGA subjects were assigned to an intervention and a nonintervention group, matched for sex and SES. The intervention group received, at the one-month visit, explicit information on infant states and their salience for development, and suggestions about calming and alerting an infant. The use of frontpacks and infant massage were also discussed. The information was given to them in written form and discussed. The nonintervention group also received written information and discussion, about general issues in infancy such as sleeping patterns and feeding. It is not known to what extent the suggestions to the intervention group were implemented.

IV. RESULTS

A. Three-month interaction patterns.

The average length for these observations was 18 8 minutes. Interaction behaviour was recorded in code in ten-second epochs, by observers who were not aware of the birth status of the infants. Levels of variables are expressed as a percentage of the total observation time in which they occurred. (Detailed information on observation procedures are available from the author)

A total of nineteen interaction variables were computed, and are described in Appendix 1. Data for 23 control group (AGA), 12 intervention (SGA/I) and 12 nonintervention (SGA/N) subjects was available. Figures 1 and 2 show the levels of frequency in the three groups of subjects, for those variables for which there were significant between-group differences ($p = 1$ or better) using the student's t-test (2-tailed). 50 % of the interaction variables had significantly different levels for intervention and nonintervention groups.

SGA infants in the intervention group vocalised in interaction more, looked at objects more frequently and were less often quiescent, than nonintervention infants, and their levels were very similar to those of control group infants. Mothers of infants in the nonintervention group vocalised to their infants less, and were more often quiescent, than mothers in the intervention group. They less often signalled to their infant in the absence of infant signalling ('mother-alone')

These levels are reflected in variables representing dyadic interaction. Levels of mutual gaze and overall interaction were lower in the nonintervention group than the intervention or control groups, and nonintervention dyads were more often both quiescent. Mothers in the intervention group were significantly less often quiescent than mothers of control group infants.

B. Six month interaction patterns.

There was only one interaction variable which was significantly different between groups at six months. Infants in the control group vocalised more frequently at this age than SGA infants in both groups.

Figures 3, 4 and 5 show the changes in levels of interaction variables from three to six months for the three groups of infants. Changes in maternal, infant and mutual gaze levels for the AGA group and the intervention group were closely similar, dropping between 3 and 6 months. In the nonintervention group, the level of maternal gaze rose over this time, while levels for the other two stayed the same.

Dyadic quiescence dropped dramatically from 3 to 6 months in the nonintervention group, and this reflects drops in levels of infant and maternal quiescence. In the other two groups infant quiescence also dropped, while maternal quiescence rose. Dyadic quiescence dropped slightly in the AGA group and rose in the intervention group.

C. Developmental Assessments.

Table 1 shows the scores for each group on the Bayley Scales of Infant Development at six and twelve months.

At six months there were no differences in mean MDI scores among groups. The PDI scores were higher for AGA than for SGA infants at this age

At 12 months, differences between AGA and SGA infants had widened with both MDI and PDI scores being significantly higher in the AGA group

There was no significant difference between intervention and nonintervention groups at this age for MDI. However for PDI the intervention group tended to have higher scores.

D. Correlations among interaction variables and developmental scores.

In order to study the relationships among patterns of interaction and developmental status in the three groups, correlations were computed between three and six month interaction variables and MDI scores at six and 12 months. (Correlations were also computed for PDI scores; since patterns were very similar to those for MDI they are not reported here).

Figure 6 displays the pattern of significant ($p=.1$ or better) correlations for AGA (control group) infants for 3 and 6 month interaction variables and 6 and 12 month MDI scores. Because the focus of interest is the pattern of correlation patterns, variables which approached significant r-values ($p=.2$) are included in brackets.

Three-month variables reflecting direct interaction in the dyads were positively related to 6 and 12 month development. In contrast few six-month variables were positively related to development at those ages, and several variables depicting direct interaction were negatively related to MDI scores.

Figure 7 shows the pattern for the SGA intervention group. As in the AGA group, direct interaction variables at three months were positively related to 6 month MDI scores though not to 12 month development. In contrast to the AGA group, a strong pattern of variables reflecting quiescence in interaction were negatively related to 6 month development. Like the AGA group, no 6 month variables were related to concurrent developmental status but some, indicating direct interaction and infant quiescence, were negatively related.

Figure 8 indicates the patterns for the SGA non-intervention group. For these infants, dyadic quiescence at 3 months was positively related to 6 month MDI, while maternal vocalising was negatively related. In contrast to the other two groups, a

range of six-month variables were positively related to concurrent development which reflected quiescence and activity unrelated to direct interaction, while in corollary interaction variables were negatively related. The only variable related to 12 month MDI was the level of looking at the observer, an aspect of behaviour that was consistently related to development in this group.

DISCUSSION

The results reported here are complex, and any discussion must be speculative. They are of interest because they replicate earlier findings both in developmental progress of SGA infants and in differences in interaction as a result of simple intervention. Furthermore, the significant correlations cluster into patterns of variables which consistently reflect particular aspects of mother-infant interaction.

The differences in the developmental status of the groups of AGA and SGA infants in this study appear to have widened over the first 12 months. Few other assessments of SGA development in infancy have been reported, and all of these indicate lags in these infants compared with appropriately grown counterparts.(e.g.Zeskind & Ramey 1981; Watt 1986b). The overall picture of development for SGA infants and children indicates that they are at some risk of delayed development in comparison with both AGA and premature infants, although these delays often show as specific problems rather than lags in global IQ scores.

The intervention reported here does not seem to be related to MDI measures at these ages, though there is a tendency in the intervention group toward more advanced motor development at 12 months. This might be because the the intervention was, at face value, a physical one, although its effect is likely to have been on several dimensions of interaction between mothers and infants which affect overall development.

The difference in levels of interaction variables for mothers and infants between intervention and non-intervention SGA dyads at three months is considerable, and replicates the finding of the pilot study. Comparison with levels of variables for the control group indicates that in most instances SGA infants and mothers who had received the intervention were behaving in interaction in a similar manner to appropriately grown infants and their mothers. Since differences are found in maternal, infant and dyadic variables these findings bear witness to the transactional nature of development in these early months. It seems that information given to mothers affected their behaviour and that of their infants.

The effect of this simple intervention procedure on patterns of interaction had apparently attenuated by the time the infants were six months of age, when there were almost no differences between AGA and SGA dyads in interaction style at least in behaviour measured here. However a more complex picture emerges when the patterns of correlations among interaction variables and developmental quotients are considered.

In the AGA group, the finding that clusters of variables reflecting direct interaction at three months are positively related to MDI scores at six and 12 months accord with a general view of optimum development in infancy. Three months is the age at which we expect maximum levels of direct eye contact and vocal exchanges between infants and parents, before objects in the environment become accessible and therefore salient to development. That the optimum progression is to object-orientation and more indirect interaction between infants and mothers at six months of age is supported by the negative relationship between the cluster of six month interaction variables and development at one year. The present findings are a clear case of what

Wachs et al (1983) call temporal specificity; variables can be in positive relationship at one level but in negative relationship at another level of development.

A similar group of three-month interaction variables was positively related to six-month MDI scores for the Intervention group,although they were not so clearly related to 12 month scores. What is striking about the SGA Intervention group is the strong negative correlations with variables indicating mother, infant, and joint quiescence and six month MDI scores. These quiescence variables were also negatively related to 12 month PDI scores. Thus it seems for this group of babies whose mothers received simple intervention that they were sensitive to both positive and negative reflections of direct interaction at three months.

In contrast, the nonintervention SGA group had few 3 month variables related to later developmental performance, but showed strong patterns of concurrent relationships both positive and negative at six months. It is notable that maternal and infant quiescence dropped dramatically from 3 to six months in this group; possibly some sort of threshold effect occurs below which some kinds of behaviour have no relation to development.

It is notable that in the other groups, concurrent 6 months measures bore little relationship to each other suggesting a lag in the effects of the interplay between developmental progress and mother-infant interaction. Both groups show links between 3-month interactions and 6 month development, and six-month interactions and 12 month development. It might be assumed that the strong negative relationships between quiescence at three months and development at 12 months in the SGA group reflects a characteristic of SGA infants in general. Figure 8 indicates that this is not the case. Three-month quiescence was in a positive relationship and, in partial corollary, a maternal stimulation variable was negatively related to 6 month MDI scores, although this effect did not carry over to 12 months. . Thus a somewhat confused picture of what related to optimum development in SGA nonintervention infants indicates quiescence in interaction, and these findings replicate broadly those reported previously between three month interaction variables and 10 month MDI scores (Watt 1986a).

One might speculate that these patterns for the nonintervention SGA subjects are evidence of the difficulty SGA infants have in coping with their environment. Other investigators have described them in the neonatal period as "wanting to be left alone" (Als et al 1976), and as having difficulty in engaging their environment. They have been described clinically as jittery infants (Fancourt 1977), and have been found to be comparatively unstable in their behaviour state organisation until at least six months (Watt 1986a). The findings here that more optimal development for the nonintervention group was related to quiescence and lack of stimulation at three months accords with the suggestion that their threshold for being overwhelmed is comparatively low.

In essence this three-month pattern is repeated in the cconcurrent relationships between interaction and MDI scores at 6 months, quiescence was positively related, and interaction variables were negatively related This resembles the pattern for the AGA and the intervention group for six month variables and later 12-month developmental status, but for the nonintervention infants there were almost no relationships between 6 month interaction and 12 month MDI scores.

In broad terms the intervention moved the overall pattern for the SGA infants in the direction of the AGA control group. Specifically, three month interaction parameters in the intervention group became salient for later development, as they were for the AGA group, whereas very few were for the nonintervention SGA group Instead, six month developmental status was sensitive to concurrent interaction parameters in this group. It seems, then, that the effect was on the paths of influence rather than the level of development attained.

It would be important to ascertain the effect of a similar intervention on AGA dyads, before knowing whether its effects are specific to SGA infants. In the meantime, the evidence here suggests that its effect was to raise the levels of interaction behaviour, possibly pushing them above a threshold which demarcates sensitivity of development to interaction. Certainly the development of nonintervention infants seemed comparatively impervious to 3 month interaction parameters, and it was not until six months when there were no differences between the groups on levels of interaction that interaction became apparently salient for concurrent development. This suggestion is supported by the fact that the 3 month variables which related to development in the intervention group were the same ones which showed significant differences in the expected direction between the intervention and nonintervention groups.

A major caveat to the impact of this intervention is the evidence for the fact that there is little or no predictiveness from assessments of infant intellectual functioning until 24 months. In a recent report Rose & Wallace (1985) demonstrated that predictiveness of developmental scores at 6 years was apparent before that age only from measures of parental education and visual novelty scores. In that regard, it is of interest to note that the variable denoted 'looking at the observer' was consistently positively related to 12 month DQ in the present study in all groups. It is likely that this measure reflected the infant's awareness of a stranger and therefore is a measure of visual, perceptual and social discrimination.

The infants in this study are being assessed annually until school age to monitor their continuing developmental patterns and to investigate the predictiveness of first year variables on later development. These findings will be supplemented by preschool teacher and parent reports. It may be that the tendency to advanced motor behaviour continues in the intervention group, or that their slight advantage merges with their intellectual skills as they grow older. It may be too that the fact of being SGA will continue to affect adversely their development.

It would be of interest to study the effects of a more elaborate intervention of this nature, given its surprising effects in the first few months. It seems that the notion of offering parents even slight structure for handling and interacting with their small fragile babies can effect a move in the direction of more 'normal', if not more advanced, development in the first year.

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APPENDIX 1: INTERACTION VARIABLES

Infant look: infant looking at mother's face

Infant vocalise: vocalisation excluding fussing and crying

Infant fuss: 'grizzling' and protest cries

Infant smile: directed at mother

Look/object: gazing at object e.g. toy, baby powder bottle, etc.

Look/observer: self evident

Maternal Look: mother looking at infant's face

Maternal vocalise: vocalisation directed at infant

Tactile stimulation: maternal rubbing, patting, hugging, rocking, kissing.

Maternal play: interaction involving giving or showing objects, playing finger games etc.

Mother-alone: epochs in which mother signals while infant is quiescent

Infant -alone: epochs in which infant signals while mother is quiescent

Maternal Quiescence: epochs in which mother is quiescent

Infant Quiescence: epochs in which infant is quiescent

Both quiescent: epochs in which both are quiescent

Maternal response: directional interactions in which mother responds to infant's signal

Infant response: directional interactions in which the infant responds to the mothers signal

Mutual gaze: infant and mother look directly at each other's faces

Total interaction: epochs in which both infant and mother signal

	n=19 AGA	n=23 SGA(total)	AGA-SGA difference	n=11 SGA/Int.	n=12 SGA/Non-Int.	Int-Non-Int. difference
6 month MDl.	$\bar{X}$ =102.5 S.D.= 17.5	$\bar{X}$ = 95.6 S.D.= 15.8	t=1.4 ns	$\bar{X}$ = 93.5 S.D.= 9.9	$\bar{X}$ =97.6 S.D.=20.4	ns
6 month PDl	$\bar{X}$ =107.5 S.D.= 16.1	$\bar{X}$ = 98.3 S.D.= 17.0	t=1.9 p= .1	$\bar{X}$ =102.3 S.D.= 11.8	$\bar{X}$ = 94.8 S.D.= 20.5	ns
12 month MDl	$\bar{X}$ =119.8 S.D.= 6.9	$\bar{X}$ =105.0 S.D.= 13.9	t=4.2 p= .001	$\bar{X}$ =103.8 S.D.= 14.9	$\bar{X}$ =106.1 S.D.= 13.5	ns
12 month PDl	$\bar{X}$ =104.7 S.D.= 10.9	$\bar{X}$ = 96.4 S.D.= 17.9	t=1.8 p= .1	$\bar{X}$ =101.9 S.D.= 13.9	$\bar{X}$ = 91.3 S.D.= 20.1	t=1.5 p= .2

TABLE 1: SIX AND TWELVE-MONTH BAYLEY SCORES

FIG. 1: MATERNAL & INFANT 3 MONTH INTERACTION VARIABLES

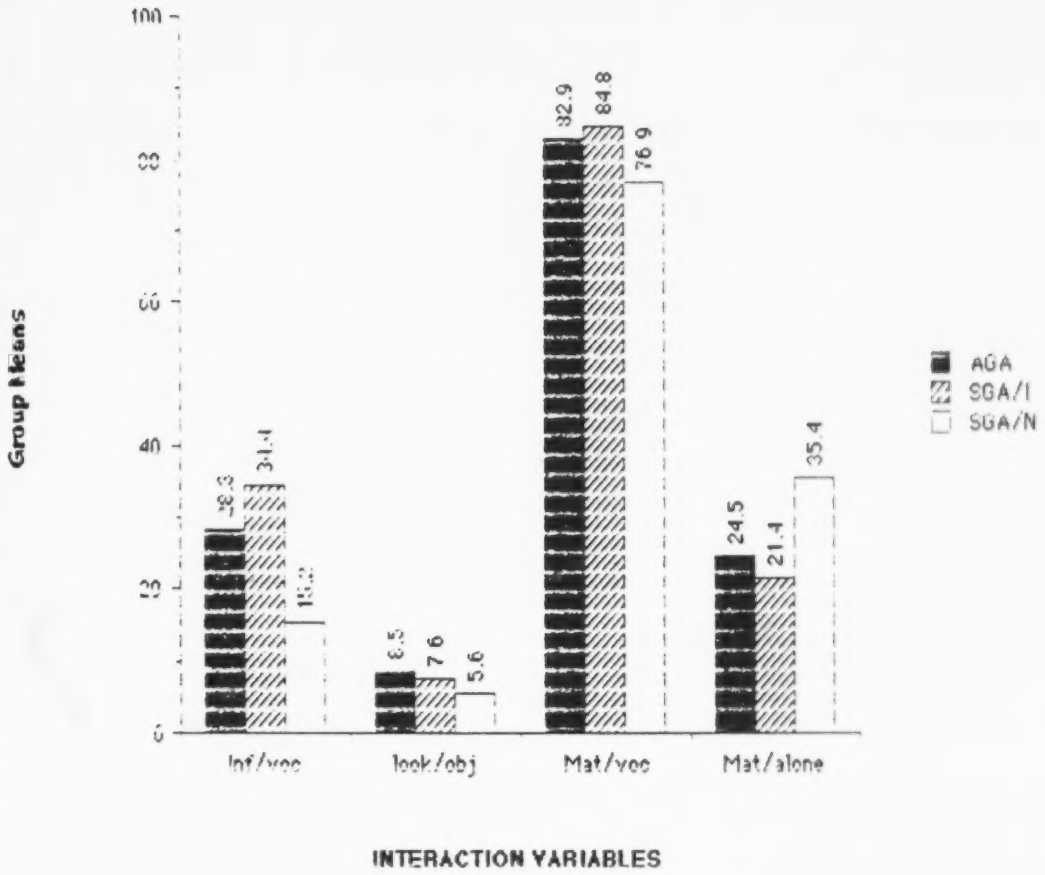
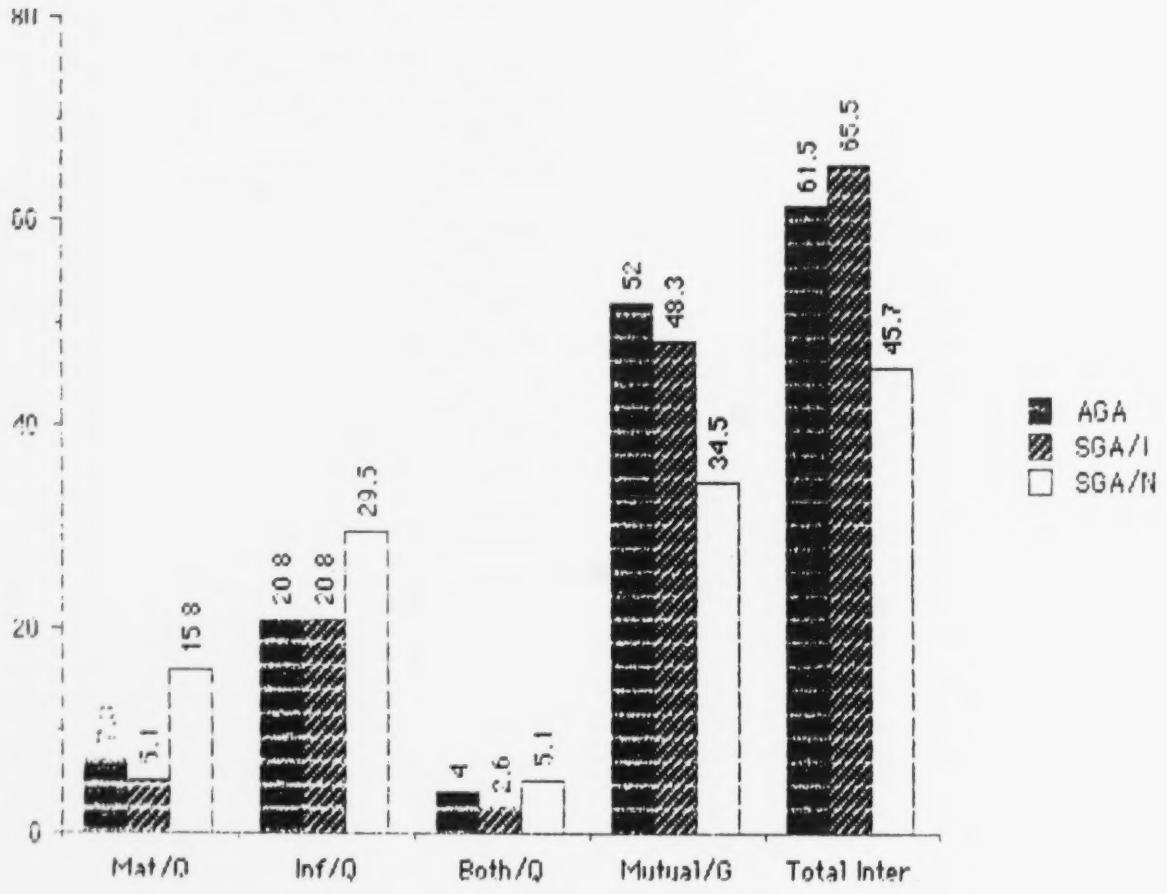
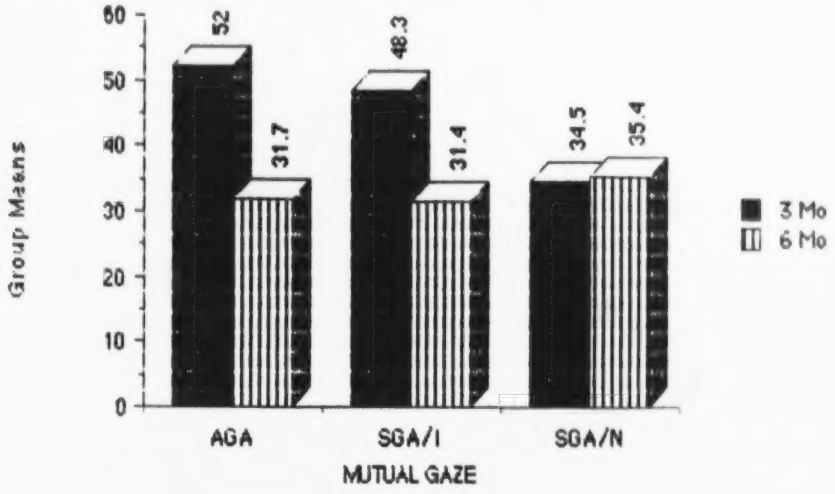


FIG.2: 3 MONTH DYADIC INTERACTION VARIABLES

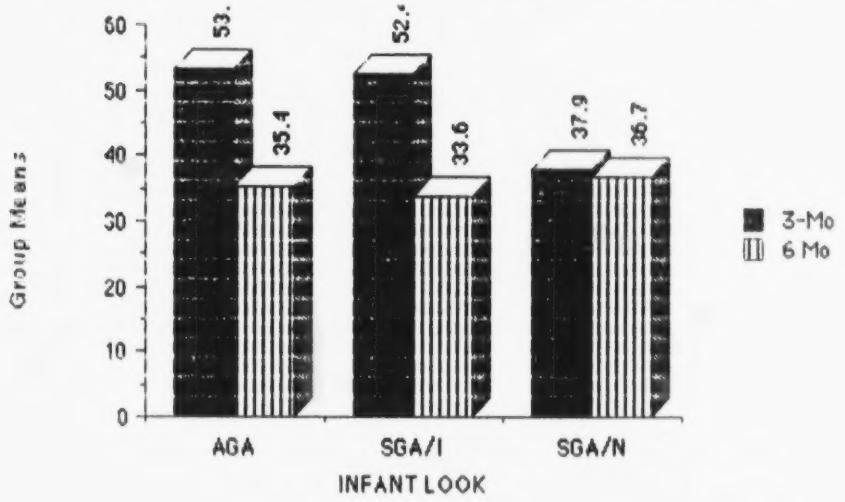


Quiescence, Mutual gaze & Total Interaction

FIG.3: MUTUAL GAZE THREE MONTH-SIX MONTH LEVELS



INFANT LOOK THREE MONTH-SIX MONTH LEVELS



MATERNAL LOOK 3 MONTH-SIX MONTH LEVELS

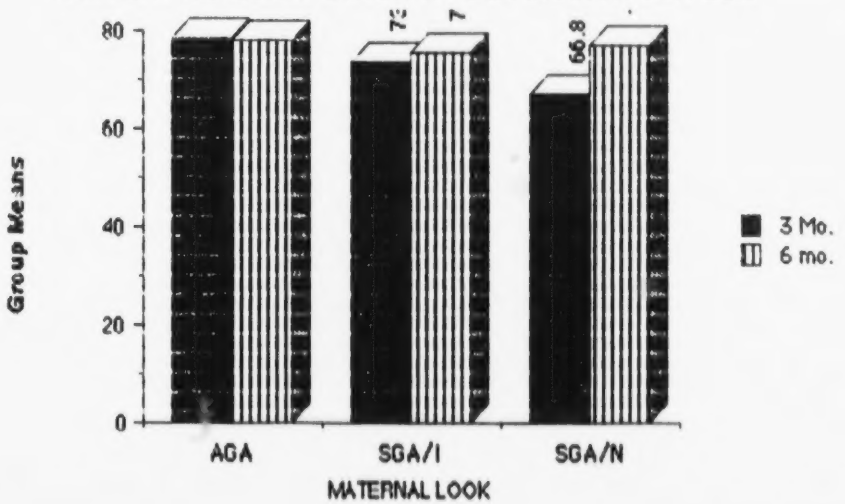
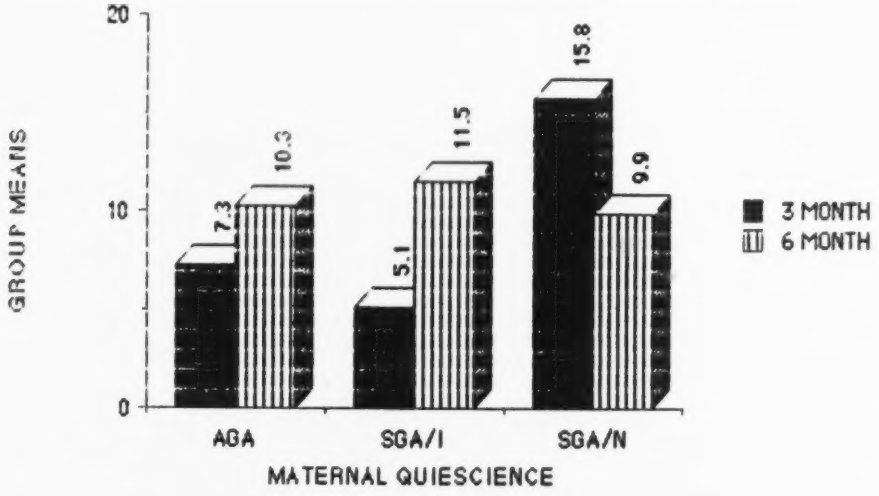
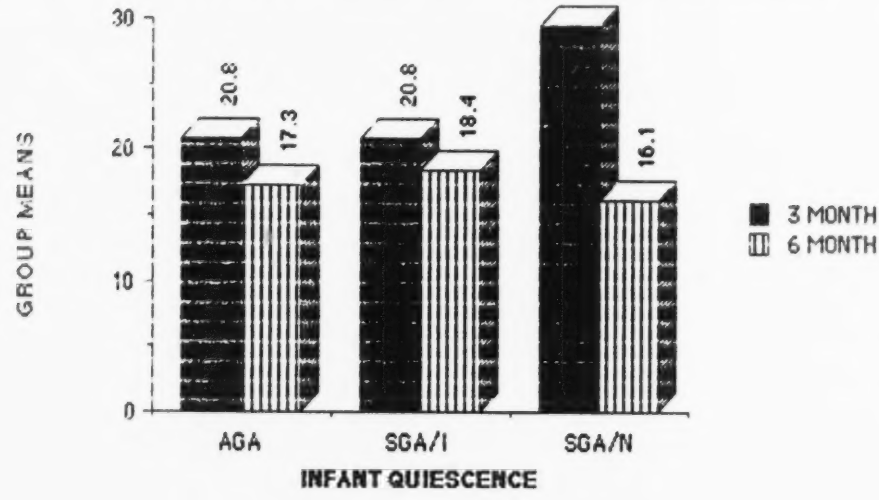


FIG. 4:

MATERNAL QUIESCENCE 3 MONTH-6 MONTH LEVELS



INFANT QUIESCENCE THREE MONTH-SIX MONTH LEVELS



MUTUAL QUIESCENCE 3 MONTH-6 MONTH LEVELS

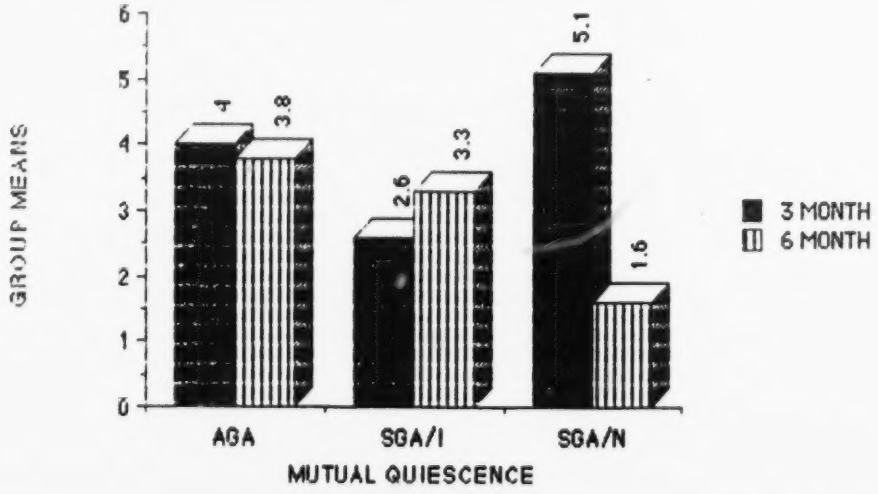
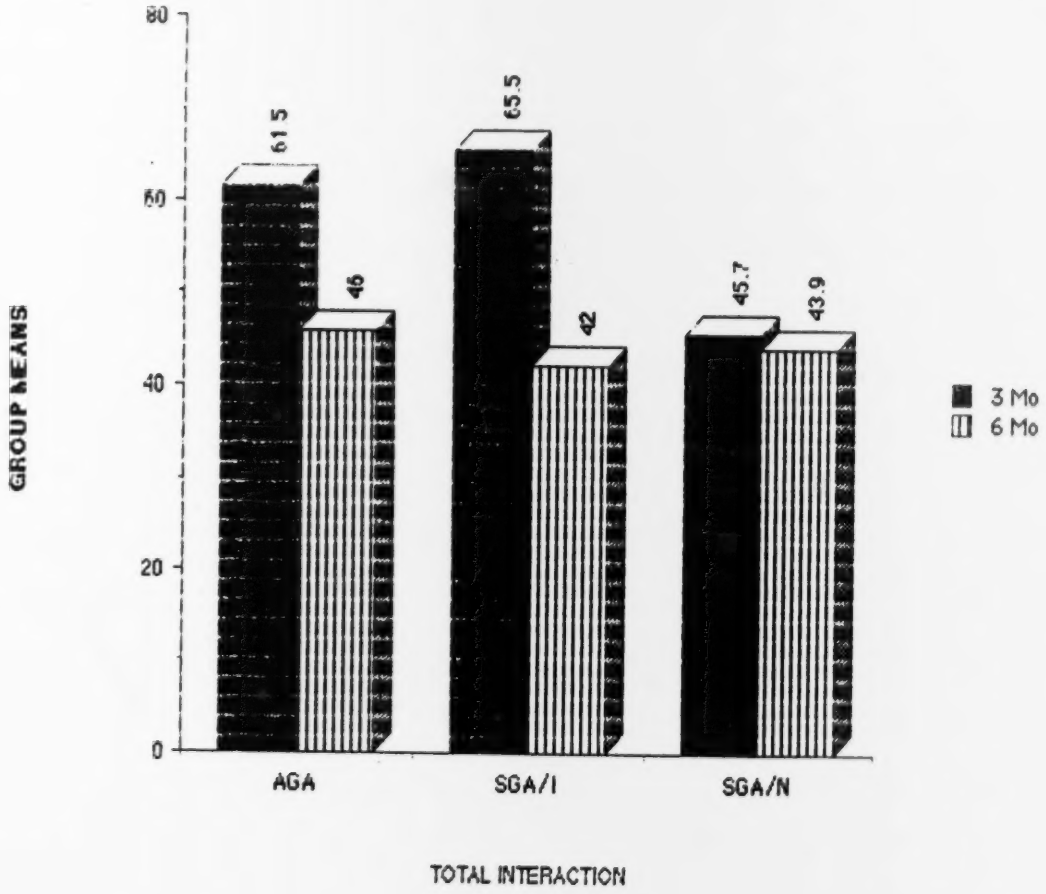


FIG.5: CHANGES IN TOTAL INTERACTION 3 MONTH-SIX MONTH



THREE MONTH VARIABLES WITH:

	Six Month MDI (n=20)	12 Month MDI (n=17)
Positive:		
	Infant look r=.5***	Infant look r=.44**
	Infant smile r=.48***	(Infant voc r=.34*)
	Maternal look r=.45***	Maternal look r=.43**
	Tactile stim. r=.38**	
	Total interaction r=.35**	
	Mutual gaze r=.54****	Mutual gaze r=.45**
	Maternal response r=.36**	Infant response r=.4**
Negative:		
	none	none

SIX MONTH VARIABLES WITH:

	Six month MDI (n=20)	12 Month MDI (n=17)
Positive:		
	(Infant response r=.35*)	look/observer r=.41**
		Maternal Quiesc. r=.37**
Negative:		
		Infant smile r=-.37**
		Maternal look r=-.5***
		Total interact. r=-.4**
		(Maternal voc. r=-.36*)
		(Mutual gaze r=-.36*)

FIGURE 6: CORRELATIONS AMONG THREE & SIX MONTH INTERACTION VARIABLES AND SIX & TWELVE MONTH BAYLEY MDI SCORES. AGA CONTROL GROUP. * p=.2, ** p=.1; *** p=.05, **** p=.02; *****p=.01.

THREE MONTH VARIABLES WITH:

	Six Month MDI (n=10)	**12 Month MDI**(n=10)
Positive:		
	Infant look r=.53**	Infant vocalise r=.54**
	Mutual gaze r=.57**	tactile stim. r=.7****
	Total interaction r=.74****	
	Maternal response r=.6**	
Negative:		
	Look/object r=-.65***	
	Mother/alone r=-.8*****	
	Infant Quiesc. r=-.9******	
	(Both Qu. -.5*)	

SIX MONTH VARIABLES WITH:

	6 Month MDI (n=10)	**12 Month MDI** (n=10)
Positive:		(Look/observer r=.46*)
		Mother/alone r=.53**
Negative:		
		Infant/alone r=-.57**
		Iinfant Quiesc. r=-.6***
		(Mutual gaze r=-.5*)

FIGURE 7: CORRELATIONS AMONG THREE AND SIX MONTH INTERACTION VARIABLES AND SIX AND 12 MONTH BAYLEY MDI SCORES: SGA INTERVENTION GROUP
*p=.2; **p=.1; ***p=.05; ****p=.02; *****p=.01.

THREE MONTH VARIABLES WITH:

Six month MDI (n=12)	**12 Month MDI** (n=12)
Positive:	
Both Quiescent r=.5**	Look/observer r=.6***
Negative:	
Maternal vocalise r=-.5**	(Infant vocalise r=-.45*)

SIX MONTH VARIABLES WITH:

Six Month MDI (n=12)	**12 Month MDI** (n=12)
Positive:	
Look/observer r=.65***	Look/observer r=.6***
Infant alone r=.57**	
Maternal Quiesc. r=.53**	
(Both Quiesc. r=.47*)	
Negative:	
Infant look r=-.57**	
Maternal look r=-.65***	
Mutual gaze r=-.58**	
Infant look/object r=-.5**	

FIGURE 8: CORRELATIONS AMONG THREE & SIX MONTH INTERACTION VARIABLES AND SIX & TWELVE MONTH BAYLEY MDI SCORES: SGA NONINTERVENTION GROUP. * p=.2; ** p=.1; *** p=.05; **** p=.02; ***** p=.01.